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Growth parameters and meat quality of pigs fed diets containing high oleic sunflower oil

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ABSTRACT: The aim of the trial was to evaluate the effects of the dietary addition of a 3% sunflower oil containing high-oleic and low-linoleic acid levels (HOSO), supplemented or not with vitamin E, on heavy pig production parameters (growth, meat quality and fatty acid composition of ham subcutaneous fat).

64 Duroc x Large White pigs were allotted to four groups (Control, Control plus vitamin E, 3% HOSO and 3% HOSO plus vitamin E).

Regardless of vitamin E supplementation, our results indicate that a 3% addition of HOSO has no effect both on growth parameters and carcass and fresh meat quality.

HOSO dietary addition resulted in a higher ($P < 0.001$) level of oleic acid and in lower levels of palmitic and stearic acids in the subcutaneous fat.

Furthermore, fat deriving from pigs on HOSO diets showed a higher ($P < 0.001$) iodine value. Nevertheless, linoleic acid level and iodine value did not exceed the maximum allowed for long-curing PDO hams.

Key words: Heavy pig, Lipids, Sunflower oil, Meat quality.

INTRODUCTION – Lipids are commonly added to swine diets to improve energy intake. To this aim either saturated fats of animal origin or chemically-hydrogenated vegetable fat are generally used. Problems arising from the use of such energy sources are mainly tied to their availability on market, cost, and digestibility that is generally lower than the digestibility of native-vegetable oils.

However vegetable oils often contain a high level of linoleic acid. Such polyunsaturated acid is responsible for both a higher nutritional value of pork (EFSA, 2005) and a lower curing aptitude of processed meat products (especially long-term cured hams).

This is the reason why, according to PDO-hams (i.e. Prosciutto di Parma and San Daniele) feeding prescriptions, diets intended for heavy pigs must not contain more than 2% of linoleic acid on a dried matter basis.

High-oleic/low-linoleic acids sunflower oils (HOSO) - that might theoretically meet the expectations tied to the improvement of the energy content without raising the linoleic acid level of swine diets - are nowadays available on market.

The aim of the present trial was to evaluate the effects of the dietary inclusion of HOSO, supplemented or not with antioxidants (vit. E), on Italian heavy pigs production parameters.

MATERIAL AND METHODS – A total of 64 Duroc x Large White pigs (initial average body weight of 70 kg) was used. Animals were homogeneously (on the basis of litter, age and body weight) allotted to four experimental groups, each containing 4 replications of 4 pigs (2 replications of castrated males and 2 replications of females), fed as follows:

- Group A (control) in which pigs received a maize/soybean diet without oil supplement.
- Group B (control + vit. E) in which pigs received the same feed as group A but with the addition of 250 ppm of vitamin E.
- Group C (HOSO) in which pigs received a feed containing 3% of high oleic sunflower oil.
- Group D (HOSO + vit. E) in which pigs received the same feed as group C but with the addition of 250 ppm of vitamin E.

The diets (control vs. HOSO) had different amount of lysine and net energy (NE), whilst lysine to NE ratio was the same across the four groups. To this aim pigs belonging to the “oil groups” (C and D) were given a lower amount of feed (91%) than the “non-oil” groups (A and B). The relative fatty acid composition of sunflower oil was: oleic acid 85.2% and linoleic acid 6.9% .

To calculate the average daily weight gain (ADG), pigs were individually weighted every 28 days. Feed intake (FI) of every replication was recorded daily to calculate feed conversion rate (FCR).

Pigs were slaughtered at about 160 kg live weight, after a 12-h fast. Immediately after slaughtering, dressing out, lean meat yield and backfat thickness of carcass were measured. At 45' post mortem, the pH value of Semimembranosus muscle was taken.

Thereafter, each carcass was dissected into the main commercial cuts and thighs were weighted. At 24 h post mortem, a second pH value of Semimembranosus muscle was recorded.

Samples of subcutaneous fat were taken (in the overhanging area of Biceps femoris muscle) from each thigh to determine the fatty acid composition by gas-chromatography. Iodine value was calculated according to AOAC (2000).

The experimental data obtained were submitted to Analysis of Variance with the diet as the main effect. The GLM procedure of SAS (1999) was used. Two orthogonal contrasts were used: no oil vs oil; no vitamin E addition vs vitamin E addition.

RESULTS AND CONCLUSIONS – Average daily weight gain (ADG), feed conversion rate (FCR) and carcass quality (lean meat yield, backfat thickness, pH values and meat colour) are shown in table 1.

Table 1. Effect of high oleic sunflower oil (HOSO) and vitamin E on growing parameters and fresh meat quality.

Item		Groups/Diets				RMSE ¹
		A	B	C	D	
		CON	CON+ vit E	HOSO	HOSO + vit E	
ADG	g/d	862	860	851	862	79.80
FCR		3.26 ^B	3.26 ^B	3.15 ^A	3.11 ^A	0.06
Fat-o-Meater	%	50.3	50.7	49.7	50.0	2.51
Backfat thickness	mm	25.7	25.2	26.9	26.4	4.63
pH 45' post mortem		6.63	6.64	6.61	6.62	0.21
pH 24 h post mortem		5.74	5.68	5.75	5.72	0.11
Colour of Semimembranosus m.						
L		45.08	45.02	45.13	44.73	3.70
Chroma		9.92	9.57	10.47	9.74	1.66
Hue		0.74	0.76	0.74	0.75	0.09

¹RMSE = root mean square error.

A,B P<0.01.

None of the above-mentioned parameters was affected by vitamin E dietary addition, therefore only HOSO effects are discussed. No significant differences were observed with respect to live weights and average daily weight gains. Feed conversion rate was significantly (P<0.01) lower in pigs belonging to the oil-supplemented groups.

According to Bosi *et al.* (2000), this result can be related to the different feed supplies that were given to the pigs to maintain the same lysine and net energy levels across the four groups.

Dietary treatment did not influence either carcass traits (dressing out, backfat thickness, lean meat yield, thigh weight) or the main qualitative parameters of meat (pH at 45' and 24h post mortem and the colour of *Semimembranosus* muscle.). Fatty acid composition of subcutaneous fat of the thighs is shown in table 2.

Table 2. Effect of high oleic sunflower oil (HOSO) and vitamin E on fatty acid composition (% of total fatty acid) of the subcutaneous fat of the thighs.

Item	Groups/Diets				RMSE ¹
	A	B	C	D	
	CON	CON+ vit E	HOSO	HOSO + vit E	
C 16:0	21.56 ^A	21.94 ^A	20.24 ^B	20.15 ^B	1.24
C 18:0	13.40 ^A	13.81 ^A	11.28 ^B	11.59 ^B	1.25
C 18:1n9	45.06 ^B	44.01 ^B	49.79 ^A	49.16 ^A	1.79
C 18:2n3	12.53	12.53	11.92	12.32	1.42
SFA	36.32 ^A	37.14 ^A	32.85 ^B	33.03 ^B	2.13
MUFA	48.96 ^B	48.37 ^B	53.43 ^A	52.82 ^A	1.63
PUFA	13.28	13.29	12.62	13.01	1.45
Iodine value	63.48 ^B	62.73 ^B	66.45 ^A	66.60 ^A	1.45

¹RMSE = root mean square error.

^{A,B} = $P < 0.001$.

As expected for swine, the fatty acids profile of the subcutaneous fat reflects the fatty acids composition of the diets. HOSO addition resulted in a higher ($P < 0.001$) level of oleic acid and in lower levels of palmitic and stearic acids. As a consequence, pigs receiving HOSO showed a higher ($P < 0.001$) level of monounsaturated fatty acids (MUFA) and a lower level of saturated fatty acids (SFA). Linoleic acid and polyunsaturated fatty acids as a whole (PUFA) were not affected by the dietary treatment.

These findings are only partially consistent with those reported by Shackelford *et al.* (1990) and Bosi *et al.* (2000) who found a higher level of PUFA when HOSO were added at a higher level (6-9%) than that used in the present experiment. In accordance with the above-mentioned results, fat deriving from pigs on HOSO diets showed a higher ($P < 0.001$) iodine value. Nevertheless, in the present experiment, linoleic acid level and iodine number did not exceed the maximum values allowed for long-curing PDO hams (IPQ, 1998).

Our results indicate that the addition of high-oleic/low-linoleic acids sunflower oil (HOSO) at a level of 3% to heavy pig diets has no effect both on growth parameters and carcass and fresh meat quality.

Further studies are still in progress to evaluate the effects of HOSO on the seasoning aptitude of long-cured hams.

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